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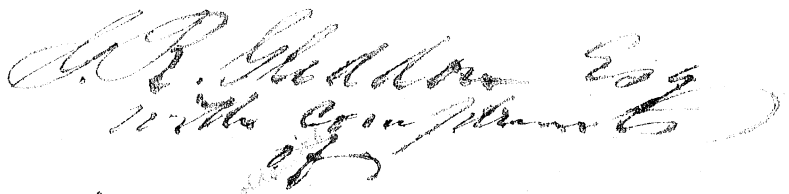
MEMOIR

ON THE

PHYSICS OF THE MISSISSIPPI RIVER,

AND CERTAIN INTERNAL IMPROVEMENTS IN THE STATE OF LOUISIANA.



CALEB G. FORSHEY, A. M., C. E.,

Late Prof. Math. and Civ. Eng. Jeff. Coll.

(Taken from the Report of the Joint Committee on Levees, La. Legislature, 1850.)

NEW ORLEANS:

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WEDNESDAY EVENING, Feb. 20, 1850.

Committee met pursuant to adjournment.

Mr. Sever introduced Professor C. G. Forshey, who left with the committee several diagrams and plans.

OLEANDA, CARROLLTON, LA., February 11th, 1850.

To the Honorable the Senate and House of Representatives of the State of Louisiana.

The undersigned, a citizen of Louisiana, has for twelve years past kept a register and devoted much labor and time to the investigation of the physics of the Mississippi river.

A period has arrived, long anticipated, when this kind of statistics and investigations are much in demand. I only regret that all I can present is so meagre. What has passed during these twelve years, I have carefully recorded, and added to these records all the materials of like kind, which I have been able to obtain from others. It may be that the accompanying facts and views are already before you, from others; but knowing of no person, myself, who has given much attention to these matters in more than a cursory way, I have been induced to offer my budget.

On a former occasion, when entrusted with the investigation of the geological resources of the State, my report of labors, by some strange fatality, was lost after it was rendered and ordered to publication. I would, if possible, place some equivalent in its stead; and though unpretending, the labors involved in these papers have cost more time in their accomplishment than the reconnoissance alluded to; and should they be deemed worthy a publication, I doubt not may prove equally valuable to the State

Very respectfully,

CALEB G. FORSHEY.

Memoir on the Physics of the Mississippi River. By CALEB G. FORSHEY, Civil Engineer.

1. *Rate of Fall.*—From the mouth of the river to a point 400 miles up its tortuous channel,* is a distance in a right line of only 220 miles. Its length is nearly double the right line distance. For 300 miles above New Orleans, it may, for practical purposes, be regarded as twice the distance of the right line.

2. The mean depth of the river at high water mark is not materially different at Natchez, from Carrollton, though near 300 miles apart. A section of the river at Carrollton, made at high water of 1849, is 168,260 square feet; and at Vidalia (opposite Natchez) the section is 167,000 feet. The bottom of an unitorm channel 400 miles up, is about on a level with the bar at the south-west pass. The rate of fall is not uniform on the surface, but decreases in declivity towards the Gulf, giving a curve of inclination (probably parabolic) to which the Gulf level is a tangent, at the Balize. The mean rate of declination is 1.80 inch per mile, for the first hundred miles, 2.00 inches the second hundred, 2.30 inches for the third, and 2.57 inches for the fourth hundred miles. [See Diagram, A. 1 and 2.] Above this point I have no accurate data, but am inclined to think that the rate is not materially different, to the upper extreme of the delta above the mouth of the Ohio. These data relate to high water.

3. The low water curve of declivity has a mean descent of .24 inch per mile for the first hundred miles, and .50, .83, 1.20 in. for the next consecutive three hundred miles; making the total difference of level 21.1 feet, from a point ten miles above Natchez, to the Balize.

4. These rates are not uniform for short distances, interrupted as the channel is by many short bends which arrest the current's regular flow, and make a series of comparative levels and falls in the surface current. The *means* obtained are from levels made of segments of the channel, 25, 28, 16, and 100 miles in length, and are, I think, reliable. They are, at least, the best data within my knowledge.

5. *Depth of Water.*—Within the 400 miles treated, the depth of the river at high water is not materially different. Near Natchez, I found an extreme depth of 188 feet, and a like depth has been found at several points in the vicinity of New Orleans. One depth of 187 feet was recently found near Shrewsbury, about ten miles above the city. These are extreme cases. When the channel is distant from both shores,

* As most of the material of this memoir was accumulated, prior to the cut-off made at Raccourci bend, the distances are taken round the old channel.

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125 feet is the usual maximum. A section made in front of Vidalia, half a mile below the Natchez ferry, gave a mean depth of 80.5 feet, with a maximum of about 130; and a like section of high water channel at Carrollton gave a mean depth of 71.6 feet. The low water depth may always be obtained by subtracting the range from the high water. At Vidalia, the range is 51 feet; and at Carrollton 15 feet. The mean depth of the low water sections would then be 29.5 feet and 56.6 feet. And the sectional areas at low water give 133,010 square feet for Carrollton, and 103,000 at Vidalia.

6 The channel continues to maintain a great depth, down to a point very near the debouchure. How near, I know not, but certainly beyond the head of the passes. At Fort Jackson it is 135 feet deep, and a point mid-way down the south-west pass was found 102 feet.

7. *Width.*—The uniformity of breadth in the channel is a remarkable feature of the Mississippi river. A great number of measurements made by myself, from the Balize to Galena, 1,700 miles up the river, give a mean width, including wide places in the bends of about 1000 yards; excluding these 800 yards; and the upper portion of this is wider, including expanses produced by bends and islands, than 1000 yards; but excluding them, they are the same. The addition of the four great rivers below, make no increase in the breadth of the river. The Missouri at Booneville, 300 miles above its mouth, I found a half a mile wide. (Vide table D, 1, 2.)

It appears, from these facts relating to the width of the Mississippi, that it does not follow the law of confluent streams, as given in the books.* We shall have occasion to see that in many other features it is a river *sui generis*.

8. *Velocity of Currents.*—To obtain the surface velocity of the river, I have established parallel sights, transverse to the river, and with an assistant, at one of the stations, timed floating drift-wood, on still days, at all parts of the surface, estimating by the eye their distance from shore. This I have done at all stages of water, and derived the mean of each set, to the number of many hundreds of observations.†

9. The result shows a mean surface velocity at high water of 2.61 miles per hour, at Carrollton, and 2.60 miles per hour at Vidalia; respectively, 3.80 and 3.82 feet per second of time. The one was derived from 176 observations, and the other from 70 observations. At low water, Carrollton, 1.45 miles per hour, or 2.11 feet per second; at Vidalia, 1.54 miles per hour, or 2.25 feet per second.

10. (Vide tables B, C, E.) The mean velocity for mean water, as derived from thirty years' observation, is 2.26 miles per hour, or 2.95 feet per second

11. The velocities at various depths are not easily obtained. The irregularities of bottom and sides in the channel, and their continually shifting nature, give so many lateral and vertical directions to portions of the current, as very much to equalise the current velocity, at all depths. Besides, the largeness of the volume renders friction much less influential than is usually computed for fluents. Accordingly, in sounding, I have found the lead, when thrown in great depths, to be drifted down stream, as fast as the boat from which it was thrown, so that my soundings were made vertically, by letting the boat drift while the lead was descending.

I have allowed, with some hesitation, one-eighth for retardation from friction, which is 12½, instead of 15 per cent, the rate usually allowed. This is a liberal allowance at high water, but at low water, it is small enough, as we shall probably see. (Vide table B, 1, 2.)

12. It is remarkable that the high water sections at Vidalia and Carrollton, 275 miles apart, should be the same; but much more remarkable, that observations should have given so precisely the same mean velocity, 2.60 and 2.61 miles per hour. This is what

* "Assuming that the Mississippi and Missouri rivers had equal breadth and discharged equal quantities, the breadth of each represented by b and their resultant by b', then $b'=1.32\,b$, and the breadth would be increased one-third. But if on the contrary the united rivers should be divided into two equal branches, each of them would have the breadth $b=0.76b'$, about three fourths of the breadth of the undivided river." Stein, Com. Rev., February, 1850.

† It may, and probably will be objected, that floating drift-wood is not a reliable index to the current's velocity, because of atmospheric friction and accidental disturbances. Some care was always taken in selecting bodies least liable to these objections, and calm days invariably chosen. The estimated distances too are liable to be erroneous, but when the objects timed are very numerous, the errors arising from estimating distances from shore may be assumed to cancel each other. Let those who have better observations offer them, I pretend only to approximations.

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The objection made by some, that a waste-weir at Bonnet Carrè would fill the lake, and first flood with water, and next fill up the bed with sediment.

Both these objections I think groundless—first, because a few inches elevation of the water enables it to spread over an outlet several miles wide; and second, because a volume equal to one-tenth part of the whole river discharged into the Lake would not deposit more than one foot per century.

Nor is there much danger, in my opinion, of a waste-weir wearing a channel, even with the nineteen feet fall of water from the river to the Lake, at Bonnet Carré.

But I am confident that the channel below would soon adapt itself to the diminished force, and there would be little or no reduction of level.

And it is certain that it would accelerate the velocity above, and increase the ravages upon the banks for twenty or thirty miles above.

Let us be careful in future how we tamper with the Mississippi river. He is a tyrant too ungovernable to be trifled with. We know too little of the physics of the river to make experiments at present; and that will be the wisest legislation which directs effort to solve its thousand unknown traits, and meantime relies upon long tried methods more powerfully and strongly applied in the future.

Without any particular theory to maintain or interest to subserve, by the adoption of a particular policy, more than the common interest of a citizen, I submit these views and facts, trusting that they may be of value at the present crisis, but perfectly ready and willing to see them entirely superceded and forgotten, whereinsoever they are not sustained by reason and truth.

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